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Abstract

Special Problems concerning the Monotube Steam Generator in the Nuclear Power Station

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The paper deals with various problems resulting from the application of the monotube steam generator in the nuclear power station.

A brief summary of these problems is given in the following two main paragraphs:

Paragraph 1

We are dealing here in a general way with problems relating to computation, design, manufacture and erection as well as in regard to special operating conditions and questions of safety. With the aid of various examples of application in the field of gas-cooled reactors [CO_2 cooled reactors of the natural uranium type, advanced gas-cooled reactors (AGR), high temperature reactors (HTGR)] a few specific problems are taken and dealt with in the light of the experience obtained from conventional steam boiler construction as well as taking into account tests and studies which have been carried out in recent times. Special importance is attached to the so-called integrated steam generator, which is located in the same pressure vessel as the reactor. Isolated results of detailed project studies are referred to.

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Paragraph 2

This paragraph deals with the dynamic problems concerning the monotube steam generator. Basically, these can be divided into two groups, i.e., one group dealing with the major disturbances which occur under special operating conditions and the other group relating to small disturbances as occur during the control procedure under normal operation. By major disturbances we mean operating conditions that bring about a change in the thermodynamic factors within a wide range, for instance, starting up, shutting down, rapid closing down of the reactor, disturbances through failure of the control system etc. A simplified model for the non-linear simulation of the steam generator on the analogue computer is shown. With the aid of some arithmetical examples for the above-mentioned reactor types the problems are specifically dealt with.

The control procedure is treated by means of a linearized theory. In the first sub-section the possible control layouts for the various fields of application are mentioned and the state connections of the thermal equilibrium factors for various load conditions are explained with examples. The calculations for the temperature and pressure distribution, which in certain circumstances may be very extensive and time consuming, are solved on the analogue computer.

The second section refers to the transfer functions of the steam generator for the various possible disturbances. Furthermore, the behaviour of the entire plant is shown by calculation results. Here again endeavour is made to set up a comparison between the three above-mentioned main fields of application. In one example the agreement of the calculation with the results of the tests on a circuit is discussed.